

M.Sc. Physics

Programme Code: 343

Course Summary

Duration: 2 years; 4 semesters

Eligibility

B.Sc. in PCM/PCB with minimum 45% marks in aggregate.

Programme specific outcome:

- ❖ Understanding the basic concepts of physics particularly concepts in classical mechanics, quantum mechanics, statistical mechanics and electricity and magnetism to appreciate how diverse phenomena observed in nature follow from a small set of fundamental laws through logical and mathematical reasoning.
- ❖ Learn to carry out experiments in basic as well as certain advanced areas of physics such as nuclear physics, condensed matter physics, nano-science, lasers and electronics.
- ❖ Understand the basic concepts of certain sub fields such as nuclear and high energy physics, atomic and molecular physics, solid state physics, Environmental Physics, astrophysics, general theory of relativity, nonlinear dynamics and complex system.
- ❖ Gain hands on experience to work in applied fields.
- ❖ To develop aptitude for formulating research problem and experimental planning, data collection and statistical planning.
- ❖ Gain a through grounding in the subject to be able to teach it at college as well as school level.
- ❖ Viewing physics as a training ground for the mind developing a critical attitude and the faculty of logical reasoning that can be applied to diverse fields

Course specific outcome:

S.No	Course code	Course name	Credits	Course outcome
1st Semester				
1	SOP/FOS/PHY/C001	Classical Mechanics	3	<p><u>In this course, the students will learn:</u></p> <p>To use Newton's laws of motion to solve advanced problems involving the dynamic motion of classical mechanical systems.</p> <p>To use differential equations and other advanced mathematics in the solution of the problems considered in item 1.</p> <p>To use conservation of energy and linear and angular momentum to solve dynamics problems.</p> <p>To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulations of classical mechanics.</p> <p>Equation of motion in Poisson Bracket form.</p>
2.	SOP/FOS/PHY/C002	Mathematical Physics	3	<p><u>In this course, the student will,</u></p> <p>Learn about Gradient, Divergence and Curl in orthogonal curvilinear and their typical applications in physics.</p> <p>Learn about special type of matrices that are relevant in physics and then learn about tensors.</p> <p>Get introduced to Special functions like Gamma function, Beta function, Delta function, Dirac delta function, Bessel functions and their recurrence relations</p> <p>Learn different ways of solving second order differential equations and familiarized with singular points and Frobenius method.</p> <p>Learn the fundamentals and applications of Fourier series, Fourier and Laplace transforms, their inverse transforms, etc.</p>
3.	SOP/FOS/PHY/C003	Electrodynamics & Astrophysics	3	<p><u>In this course the student will,</u></p> <p>Learn about Maxwell's equations and their physical significance.</p> <p>Get introduced to equation of continuity and relaxation time, Vector and scalar potentials, Lorentz and Coulomb gauge, electromagnetic energy and Poynting's theorem.</p> <p>Learn the fundamental of electromagnetic wave equations in free</p>

				space, their plane wave solutions. Concept of Retarded potentials, Lienard Wiechert potentials,
4.	SOP/FOS/PHY/C004	Electronics	3	Design and analyze the basic operations of MOSFET. Know about the Power amplifier using BJT and FET in various configuration to determine frequency response and concept of voltage gain. Know about different power amplifier circuits, their design and use in electronics and communication circuits. Know the concept of feedback amplifier and their characteristics. Design the different oscillator circuits for various frequencies.
5.	SOP/FOS/PHY/C005	Laboratory Course I (Practical –I)	3	To impart practical knowledge and hands on training on LCR circuit, Transistorized LCR bridge, UJT, MOSFET NPN and PNP transistor characteristics , DIAC, TRIAC, FET, R.C.coupled amplifier, Hartley oscillator, Colpit oscillator, Wien bridge oscillator.
6.	SOP/FOS/PHY/C006	Laboratory Course II (Practical –II)	3	For each student two seminars are conducted.
2nd Semester				
1.	Course Code	Course name	Credits	Course outcome
	SOP/FOS/PHY/C007	Atomic &, Molecular Physics	3	<u>In this course, students will learn:</u> Atomic Spectroscopy: Fine structure of Hydrogen lines, alkali atom Spectra, penetrating and non penetrating orbits, electron spin orbit interaction. Zeeman Effect, Paschen Back Effect, Hyper fine structure, Stark effect, width of spectral lines, lamb shift Molecular Spectroscopy: Rotational spectra of diatomic molecules, non rigid rotator, vibrational spectra enharmonic oscillator explanation of rotational vibrational spectra in infrared, molecular dissociation and calculation of dissociation energy
2.	SOP/FOS/PHY/C008	Solid State Physics	3	<u>In this course, students will learn:</u> Reciprocal lattice: diffraction waves by crystals, Braggs law, Scattered wave amplitude, Laue equations, Brillouin zones Crystal Binding and Elastic Constants: Ionic Crystal, Covalent Crystal, Metals, Hydrogen bonds, analysis of elastic springs Lattice Vibrations: Vibrations of crystals with monatomic basis, First

				Brillouin zone, Group Velocity, Long wavelength limit
3.	SOP/FOS/PHY/C009	Statistical Physics	3	<p><u>In this course, students will learn:</u></p> <p>Application of classical distribution to the ideal gases: Helmholtz free energy, Gibb's free energy, entropy and thermodynamic properties, Gibb's paradox, Sakur-tetrode equation.</p> <p>Black Body Radiation: Planck's distribution, pressure and energy relationship of photons, black body radiation, Rayleigh Jean's formula, Wein's law, Wein's displacement formula, absorption and emission of radiation, Stefan's law, high temperature measurements.</p>
4.	SOP/FOS/PHY/C010	Quantum Mechanics	3	<p><u>In this course, students will learn:</u></p> <p>Matrix Formulation of Quantum Mechanics: Hilbert space. Dirac bra and ket notation, projection operators, Schrodinger.</p> <p>Approximation Methods for Bound State: Time independent perturbation theory for non-degenerate and degenerate systems upto second order perturbation.</p>
5.	SOP/FOS/PHY/C011	Laboratory Course I (Practical –I)	3	Practice different types of wiring and instruments connections of Multivibrator bistable/monostable/Astable, Ionisation potential of Mercury using gas filled diodes, Michelson interferometer, Fresnel's law, B-H curve amplitude modulation and demodulation, frequency modulation and demodulation, CRO.
6.	SOP/FOS/PHY/C012	Laboratory Course II (Practical –II)	3	Two seminars for each student are conducted.
3rd Semester				
S.no	Course Code	Course name	Credits	Course Outcome
1.	SOP/FOS/PHY/C013	Advanced Quantum Mechanics	3	<p><u>In this course, students will learn:</u></p> <p>Scattering Theory: Partial wave analysis: asymptotic behaviour of partial waves, phase shifts, scattering amplitude in terms of phase shifts, cross-sections, Optical theorem. Phase shifts and its relation to potential, effective range theory. Breit-Wigner formula for one level and two levels, non-resonant scattering. s-wave and p-wave resonances.</p> <p>Quantization of wave fields: The quantization of wave fields, Classical and quantum field equations quantization of non-relativistic</p>

				Schrodinger equation, second quantization, N-representation, creation and annihilation operators.
2.	SOP/FOS/PHY/C014	Nuclear Physics	3	<p><u>In this course, students will learn:</u></p> <p>Nuclear Forces and Detectros – Ground state of deuteron, Low energy neutron-proton scattering and proton-proton scattering, Exchange and tensor forces, G.M. Counter, Electron & Proton Synchrotron.</p> <p>Nuclear Reactions- Q-value of nuclear reaction, Bohr's Theory of compound nucleus, Scattering cross section of nuclear reaction (phase shift method), Breit Wigner single level resonance formula for scattering cross section.</p>
3.	SOP/FOS/PHY/E001	Condensed Matter Physics A	3	<p><u>In this course, students will learn:</u></p> <p>Diffusion, Colour centres, F-Centre, V-Centre, dislocation, Line defects, edge dislocation, screw dislocation, Burger vector.</p> <p>Dielectric and electrical properties of insulators: Macroscopic description of dielectric constants, static, electronic and ionic polarizability of molecules</p>
4.	SOP/FOS/PHY/C015	Laboratory Course I (General)	3	In this course, students perform experiments on e/m by Zeeman effect, G.M.counter, IC- Based Power supply, Absorption spectroscopy by spectrophotometer, optoelectronic devices, FET amplifier
5.	SOP/FOS/PHY/E002	Electronics A	3	<p><u>In this course, students will learn:</u></p> <p>Number Systems, Boolean Algebra & Basic Logic Gates, Memory Devices & IC-Technology:</p> <p>Logic Gates, Combinational Circuits, Sequential Circuits.</p>
6.	SOP/FOS/PHY/E003	Laser Physics A	3	<p><u>In this course, students will learn:</u></p> <p>Einstein's coefficients, population inversion, theory of optical resonators, laser modes, spatial and temporal coherence.</p> <p>Types of lasers, Non linear optics, Laser spectroscopy.</p>
7.	SOP/FOS/PHY/E004	High Energy Physics A	3	<p><u>In this course, students will learn:</u></p> <p>Classical Lagrangian Equation, Classical Hamiltonian Equations, Gauge Invariance, Quantization of Dirac field covariant anti commutation relations.</p> <p>Feynman Diagrams and Feynman rules for QED in configuration and</p>

				momentum space, Renormalization of QED
8.	SOP/FOS/PHY/E005	Astrophysics A	3	<u>In this course, students will learn:</u> Superdense Objects: Mechanism of Mass transfer in Binary Stars. Use of polytropic models for completely degenerate stars Stellar Evolution: Abundance of elements in the sun by the method of fine analysis-Stromgren's method, use of weight functions, abundances of elements in normal stars.
9.	SOP/FOS/PHY/E006	Laboratory Course II (Circuit Design)	3	Circuit Design: Designing of Combinational, Sequential circuits.
4th Semester				
S.no	Paper Code	Paper	Credits	Course Outcome
1.	SOP/FOS/PHY/C016	Computational Physics	3	<u>In this course, students will learn:</u> Roots of functions, interpolation, extrapolation, Gaussian elimination. Flowchart, C-Programming & algorithms-Problem analysis flowchart of some basic problems,
2.	SOP/FOS/PHY/C017	Particle Physics	3	<u>In this course, students will learn:</u> Classification and Properties of Elementary Particles, Conservation Laws and Gauge Invariances, Quark Model.Eight fold way, Quarks as building blocks of hadrons, six quarks (u,d,s,c,t and b), Antiquarks, General properties of quarks.
3.	SOP/FOS/PHY/C018	Lab Course	3	In this lab course, students do C programming based on numerical computational methods.
4.	SOP/FOS/PHY/E007	Condensed Matter Physics B	3	<u>In this course, students will learn:</u> Dielectrics and ferroelectrics: Polarization, Macroscopic electric field, depolarization fields, local electric field at an atom, fields of dipoles inside cavity, dielectric constant and polarizability. Carbon nanobud: carbon nanotubes as quantum wires, Areas of Nanotechnology, nanomaterials, nanoelectronics, nanobiotechnology, nanofabrication, microelectromechanical systems (MEMS)
5	SOP/FOS/PHY/E008	Electronics B	3	<u>In this course, students will learn:</u> Communication: Modulation, Demodulation, Transmitters & Receivers, Transmission Lines, Antennas, Propagation of Radio

				Waves, Radar Systems
6.	SOP/FOS/PHY/E009	Laser Physics B	3	<u>In this course, students will learn:</u> Electro optic effect, longitudinal and transverse phase modulation, Optical sources and detectors, Fibre optics, Holography.
7.	SOP/FOS/PHY/E010	High Energy Physics B	3	<u>In this course, students will learn:</u> Symmetries and conservation laws, Noether's Theorem, U (1) Gauge Invariance, Baryon and Lepton number conservation, Weinberg- Salam theory of electroweak unification, The classic predictions of SU (5) Grand Unified, Theory, quark and Lepton masses.
8.	SOP/FOS/PHY/E011	Astrophysics B	3	<u>In this course, students will learn:</u> Detectors, Photometry and Spectroscopy, Galactic System, Gravitation & Cosmology.
9.	SOP/FOS/PHY/E012	Project/Dissertation	3	The dissertation is in-depth study on a particular subject related to Physics where the student carries out a <i>mini</i> research-type activity under one supervisor. The subjects of dissertation are in the field of Bio-Physics, Nano-Physics, Statistical Physics, VLSI Design and System, Mathematical Physics. In many instances, this may lay the foundation of a research career for a student. Which is why it is very important for student to choose the right topic